RADIO-PARAMETER CONTROL IN MOBILE RADIO COMMUNICATIONS SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a mobile radio communications system and in particular to a control technique of radio parameters in the mobile radio communications system.

2. Description of the Related Art

A mobile radio communications system, typically a code division multiple access (CDMA) radio communication system, is composed of a plurality of base stations each forming radio zones (cells or sectors) to provide a service area. A mobile station (MS) can move throughout the service area without interrupting communication with a given base station. Since the mobile station moves away from or closer to a base station, into abuildingorbetweenbuildings, oracrossboundariesbetween adjacent radio zones, a radio-frequency (RF) propagation condition will dynamically change. Such changing RF propagation conditions are likely to cause poor communication, especially when communication needs to be handed off from one basestationtoanother. Toimprovethequalityofcommunications, some handoff control techniques have been proposed.

Japanese Patent Application Unexamined Publication No. P2001-136558A discloses a handoff-parameter control technique using a status monitor installed at a location in an overlapping

area of two adjacent radio zones. More specifically, each base station periodically transmits a pilot signal and the status monitor receives the pilot signal to monitor Ec/Io, where Ec is a received signal strength of the pilot signal and Io

5   is a received interference strength. The conventional handoff-parameter control technique changes handoff parameters (e.g. IS-95 CDMA soft handoff parameters such as an add threshold T_ADD and a drop threshold T_DROP) based on the monitored Ec/Io at all times. Since the handoff parameters are controlled

10   depending on Ec/Io in which Io may dynamically change, the handoff parameters can be rapidly set to appropriate values in response to varying loads of the system.

However, the conventional handoff-parameter control technique uses the status monitor installed only in an overlapping

15   area of two adjacent radio zones. Accordingly the handoff parameter control can be performed using the monitored Ec/Io only when a mobile station is moving by the status monitor.

Japanese Patent Application Unexamined Publication No. P2001-136562A discloses a system for obtaining location

20   information of a mobile station by providing a plurality of point communication terminals within each cell to allow accurate location detection of a mobile station. However, this conventional system is designed to obtain accurate location information of a mobile station, not to control radio parameters.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a radio-parameter control method and system, which can improve communication quality by performing fine radio-parameter

5   setting.

Another object of the present invention is to provide a radio-parameter control method, which can control radio parameters for a mobile station before reaching a predicted location within a radio zone.

10   According to the present invention, a system for controlling radio parameters for use in radio communication between a base station and a mobile station, includes: a plurality of mobile stations, each of which has a position detector for detecting a current location of its own; a plurality of base stations

15   each forming a plurality of radio zones, in which a mobile station is allowed to communicate with a corresponding base station, wherein each of the base stations periodically transmits a down-link reference signal; a plurality of fixed stations, which are distributed at predetermined locations in a service area

20   composed of the plurality of radio zones, wherein each of the fixed stations receives the down-link reference signal from a corresponding base station to produce received-signal condition data of the down-link reference signal; a statistical analyzer for statistically analyzing the received-signal condition data

25   received from each of the plurality of fixed stations to store

statistical condition data at each of the fixed stations in a statistical condition memory; a mobile-station movement estimator for estimating a future location of the mobile station based on detected current locations of the mobile station and

5   the predetermined locations of the fixed stations; and a parameter controller for controlling radio parameters for use in radio communication between the mobile station and a base station corresponding to the future location of the mobile station based on statistical condition data at the future location of the mobile

10   station.

The fixed stations are preferably distributed at predetermined locations where radio-frequency propagation environment easily changes or a number of mobile stations are likely to congregate.

15   The radio communication between a base station and a mobile station preferably conforms to a code division multiple access (CDMA) scheme. Each of the fixed stations receives a down-link pilot channel signal from a corresponding base station to monitor a received-signal strength as condition data.

20   The statistical analyzer may analyze the received-signal condition data for each of the fixed stations according to at least one of time periods of day, days of week, months and weather conditions around respective ones of the fixed stations. The weather conditions may be supplied from an outside system such

25   ass a maintenance and operation center.

Each of the fixed stations may transmit the received-signal

condition data to the statistical analyzer by a wireless channel. Alternatively, the received-signal condition data may be transmitted by a wired channel.

According to another aspect of the present invention,
5   A method for controlling radio parameters for use in radio communication between a base station and a mobile station in a mobile radio communication system comprising: a plurality of mobile stations, each of which has a position detector for detecting a current location of its own; a plurality of base
10   stations each forming a plurality of radio zones, in which a mobile station is allowed to communicate with a corresponding base station, wherein each of the base stations periodically transmits a down-link reference signal; and a plurality of fixed stations, which are distributed at predetermined locations in a service
15   area composed of the plurality of radio zones, wherein each of the fixed stations receives the down-link reference signal from a corresponding base station to produce received-signal condition data of the down-link reference signal, wherein the method comprises: a) receiving the current location of
20   the mobile station; b) receiving the received-signal condition data of the down-link reference signal from each of the fixed stations; c) statistically analyzing the received-signal condition data to store statistical condition data at each of the fixed stations in a statistical condition memory; d) estimating
25   a future location of the mobile station based on detected current locations of the mobile station and the predetermined locations

of the fixed stations; and e) controlling radio parameters for use in radio communication between the mobile station and a base station corresponding to the future location of the mobile station based on statistical condition data at the future location

5   of the mobile station.

The step c) preferably includes the step of statistically arranging the received-signal condition data according to at least one of time periods of day, days of week, months and weather conditions around respective ones of the fixed stations, wherein

10   the statistical condition data are retrievably stored in the statistical condition memory.

According to still another aspect of the present invention, a mobile radio communications system includes: a plurality of mobile stations, each of which has a position detector for

15   detecting a current location of its own; a plurality of base stations each forming a plurality of radio zones, in which a mobile station is allowed to communicate with a corresponding base station, wherein each of the base stations periodically transmits a down-link reference signal; a plurality of fixed stations,

20   which are distributed at predetermined locations in a service area composed of the plurality of radio zones, wherein each of the fixed stations receives the down-link reference signal from a corresponding base station to produce received-signal condition data of the down-link reference signal; and a

25   radio network control station accommodating the mobile stations, the base stations and the fixed stations, wherein the radio network

control station comprises: a statistical analyzer for statistically analyzing the received-signal condition data received from each of the plurality of fixed stations to store statistical condition data at each of the fixed stations in

5   a statistical condition memory; a mobile-station movement estimator for estimating a future location of the mobile station based on detected current locations of the mobile station and the predetermined locations of the fixed stations; and a parameter controller for controlling radio parameters for use in radio

10   communication between the mobile station and a base station corresponding to the future location of the mobile station based on statistical condition data at the future location of the mobile station.

As described above, according to the present invention,

15   RF condition at an estimated location that a mobile station will reach can be predicted based on statistical condition data. Accordingly, necessary radio parameters can be controlled depending on the predicted condition and therefore a more highly accurate radio parameter control can be achieved. Since the

20   statistical condition data stored in the statistical condition memory are updated at regular intervals, the latest statistical condition data can be used to predict RF condition at a desired location where a mobile station will make an approach.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing a mobile radio communications system according to a first embodiment of the present invention;

Fig. 2 is a block diagram showing an example of a radio network

5   control station of the mobile radio communications system according to the first embodiment of the present invention;

Fig. 3 is a block diagram showing an example of a fixed station of the mobile radio communications system according to the first embodiment of the present invention;

10   Fig. 4 is a block diagram showing an example of a mobile station of the mobile radio communications system according to the first embodiment of the present invention;

Fig. 5 is a diagram showing an example of contents of a data memory in the radio network control station as shown

15   in Fig. 2;

Fig. 6A is a diagram showing a statistical condition memory in the radio network control station as shown in Fig. 2;

Fig. 6B is a diagram showing an example of statistical conditions tables for a fixed station in the statistical

20   condition memory as shown in Fig. 6A;

Fig. 7 is a flowchart showing statistical processing according to the first embodiment of the present invention;

Fig. 8 is a flowchart showing a radio parameter control method according to the first embodiment of the present invention;

25   and

Fig. 9 is a block diagram showing another example of a radio network control station of the mobile radio communications system according to the first embodiment of the present invention.

5   DESCRIPTION OF THE PREFERRED EMBODIMENT

System configuration

Referring to Fig. 1, a CDMA communications system according to an embodiment of the present invention is provided with at least one radio network control station (RNC) 20 connected to

10   a core network 10. The radio network control station 20 accommodates a plurality of radio base stations, each controlling radio zones or cells with adjacent radio zones overlapping to form a wide service area. A mobile station (MS) 60 can move in the service area without interrupting communications. In

15   Fig. 1, for the sake of simplicity, one radio network control station 20 and two base stations 40 and 50 are shown, which provide radio zones 41 and 51, respectively. a plurality of radio network control stations 20 may be provided to increase the number of base stations accommodated therein. The

20   radio network control station 20 may be connected to a maintenance and operation center 30 directly or through a network (not shown). The maintenance and operation center 30 can transmit weather information for each radio zone to the radio network control

station 20. Alternatively, such weather information may be
supplied from a weather observation system or manually inputted
by an operator.

Within each radio zone, a fixed station FS is installed
5   at a predetermined location preferably where radio-frequency
propagation environment easily changes or a number of mobile
stations are likely to congregate. It is possible to distribute
a plurality of fixed stations at predetermined locations in
a service area of the mobile communications system so that a
10   fixed station FS is installed where radio-frequency
propagation environment easily changes or a number of mobile
stations are likely to congregate. In Fig. 1, it is assumed
for the sake of simplicity that fixed stations FS_1 and FS_2 are
installed in the radio zone 41 and fixed stations FS_3 and FS_4
15   are installed in the radio zone 51. Each fixed station FS receives
a pilot channel signal from a corresponding base station BTS
to monitor a received signal strength and transmits the monitored
data to the radio network control station 20 through the
corresponding base station BTS.

20   The respective fixed stations FSs can communicate with
corresponding base stations by radio channels. Here, the fixed
stations FS_1 and FS_2 can communicate with the base station 40
and fixed stations FS_3 and FS_4 can communicate with the base
station 50. Since each fixed station FS transmits only monitored
25   data to the radio network control station 20 through a corresponding
base station, interference power on up-link increases in some

degree. If an increase in interference power on up-link is not negligible, then each fixed station FS may be connected to the radio network control station 20 by a wired line as shown by dashed lines in Fig. 1.

5   The mobile station 60 is typically a mobile telephone set or a portable communication terminal, which is provided with a position detecting means for detecting a more accurate location of the mobile station, such as a GPS (Global Positioning System) receiver. In this embodiment, the mobile station 60

10   is equipped with the GPS receiver, which can receive GPS signals from GPS satellites 70 to detect its current location. The mobile station 60 transmits current location data to the radio network control station 20 through a corresponding base station. Alternatively, the mobile station 60 may transmit received GPS

15   data to the radio network control station 20 through a corresponding base station and the radio network control station 20 may compute the location of the mobile station 60. In Fig. 1, one mobile station 60 is shown for the sake of simplicity. Needless to say, a plurality of mobile stations can be accommodated in each

20   radio zone. Each mobile station can communicate with another terminal or mobile station accommodated in another network through the radio network control station 20 and the core network 10.

The radio network control station 20 is provided with memories 21 and a statistical analysis section 22, which

25   performs statistical processing of monitored data received from the fixed stations as described later. The statistically

processed condition data are stored in a monitored data memory

of the memories 21. Based on the statistically processed condition

data, the current location, direction and velocity of

a moving mobile station 60, and current environment such as

5   weather information, the radio network control station 20

previously controls radio parameters, such as a transmission

power control reference level and handover criteria, for a mobile

station, a corresponding base station and a next base station

which will accommodate the mobile station soon. The details

10   will be described later.

In this manner, the radio parameters are modified in advance

of movement of the mobile station and the statistically processed

condition data are updated periodically, resulting in improved

communication between a moving mobile station 60 and related

15   base stations. The accuracy of statistically processed condition

data can be made higher depending on the number of fixed stations

and the distribution thereof.

Radio network control station

As shown in Fig. 2, the radio network control station

20   20 is connected to the core network 10, the maintenance and

operation center 30, and the accommodated base stations through

respective interfaces 201-203. The radio network control station

20 is provided with a processor 204, which is a program-controlled

processor for running software programs to implement radio network

25   control operations. The processor 204 is connected to a monitored

data memory 205, a statistical condition memory 206, a
radio-parameter memory 207, a clock/calendar circuit 208, and
a program memory 209. The program memory 209 previously
stores necessary software programs including a statistical
5   analyzer, a mobile-station movement estimator, a parameter
controller, and other necessary programs.

The monitored data memory 205 stores condition data that
are monitored by respective ones of the fixed stations FS_1-FS_N.
Such condition data monitored by each fixed station includes
10   a received signal strength and a signal deterioration degree
of a pilot signal received from at least one base station. Weather
information around each fixed station, which is supplied by
the maintenance and operation center 30, may be also stored
in the monitored data memory 205.

15   The statistical condition memory 206 stores statistically
processed condition data for respective ones of the fixed stations
FS_1-FS_N. As described in detail later, the monitored condition
data are statistically analyzed according to various conditions,
for example, time periods of a day. The statistically processed
20   condition data are stored for respective ones of the fixed stations
FS_1-FS_N and are used to predict a RF propagation condition which
a moving mobile station 60 is to reach.

The radio-parameter memory 207 stores radio parameters
including a reference level for transmission power control and
25   handover criteria (e.g. IS-95 CDMA soft handoff parameters such
as an add threshold T_ADD and a drop threshold T_DROP). As described

in detail later, these radio parameters for a mobile station and base stations communicating with the mobile station are updated in advance depending on a predicted location of the mobile station and its predicted RF propagation environment.

5   The clock/calendar circuit 208 supplies a time of day to the processor 204. Such a time of day is used to determine time periods of day, days of week, and months.

           The program memory 209 stores control programs necessary for the RNC operations, including statistical
10   analyzer, mobile-station movement estimator, and a parameter controller. The processor 204 reads these programs to perform statistical processing of monitored data, computation of the direction and velocity of a moving mobile station 60, prediction of future locations of the mobile station 60, and parameter
15   updates depending on predicted locations of the mobile station 60 and predicted RF propagation environments.

Fixed station

           As shown in Fig. 3, each of the fixed stations FS_1-FS_N is provided with a transceiver 101, a condition monitor 102,
20   a program-controlled processor 103 and a memory 104. The transceiver 101 receives a pilot signal or a reference signal on a down-link common pilot channel (CPICH) from a corresponding base station at all times. The received signal is output to the condition monitor 102. The condition monitor 102 monitors
25   a power level of a received signal and a degree of received-signal

deterioration for each radio zone/frequency. The power level
of a received signal and the degree of received-signal
deterioration are returned as monitored condition data to the
transceiver 101. The monitored condition data are transmitted

5   on an up-link random access channel back to the radio network
control station 20 through the corresponding base station.

    The processor 103 reads a program from the memory 104
to control the transceiver 101 and the condition monitor 102
so as to perform the above-described condition monitoring

10   operation. The fixed station FS is installed preferably at a
location where radio-frequency propagation environment easily
changes or a number of mobile stations are likely to congregate.

    As described before, if an increase in interference power
on up-link is not negligible, then each fixed station FS may

15   be connected to the radio network control station 20 by a wired
line as shown by dashed lines in Fig. 1. In such a case, the
transceiver 101 is replaced with a receiver and a wired transmission
controller is further provided so as to transmit the monitored
condition data to the radio network control station 20 through

20   the wired line.

Mobile station

    As shown in Fig. 4, each of mobile stations 60 is provided
with a transceiver 601, a channel controller 602, a user interface
603, and a processor 604. The processor 604 may be a

25   program-controlled processor, which performs mobile

communication operationssuchasmobiletelephonecommunication

by running programs stored in the ROM 607 thereon using a RAM

606. The mobile station 60 can communicate with the other party

through a corresponding base station, the radio network control

5   station 20 and the core network 10.

Themobilestation 60isfurtherprovidedwithaGPSreceiver

605, which receives GPS data from GPS satellites and compute

thelocationofitsownfromtheGPSdata. Theprocessor604notifies

the radio network control station 20 of the detected location

10   information through the corresponding base station.

Alternatively, the mobile station 60 may transfer the

receivedGPSdatatotheradio network controlstation20without

computing its own location. In this case, the radio network

control station 20 computes the location of the mobile station

15   60.

Monitored data memory

As shown in Fig. 5, the monitored data memory 205 stores

location/area data, monitored condition data and weather

information of respective ones of the fixed stations FS_1-FS_N.

20   Condition datamonitoredbyeachfixedstationincludesareceived

signal strength (RL) and a signal deterioration degree (DSD)

of a pilot signal. These data may be updated at regular intervals

and are accumulated for a predetermined time period to allow

statistical analysis.

25   The location/area data L_1-L_N indicate predetermined areas

around respective ones of the fixed stations FS_1-FS_N. As shown

in Fig. 1, the predetermined areas of the fixed stations FS_1,

FS_2, FS_3 and FS_4 are indicated by doted circles 41.1, 41.2, 51.1

and 51.2, respectively. The condition data received from a fixed

5   station is estimated to be the RF propagation condition in the

predetermined area around the fixed station.

Statistical condition memory

       As shown in Fig. 6A, the statistical condition memory

206 stores N data records each including statistical condition

10   tables and each corresponding to the fixed stations FS_1-FS_N.

An example of a set of statistical condition tables for a fixed

station FS_i is shown in Fig. 6B.

       As shown in Fig. 6B, a data record for a fixed station

FS_i is composed of a plurality of statistical condition tables.

15   In this example, three tables each corresponding to weather

conditions are shown: fine; cloudy; and rainy. It is possible

to provide a further set of tables each corresponding to months

or seasons.

       Each table contains monitored condition data, which are

20   arranged in rows indicating days of a week SUN-SAT and columns

indicating time periods of day T_1-T_M. The time periods T_1-T_M

are obtained by dividing a day (24 hours) by a predetermined number.

Each entry identified by a day of a week and a time period of

day contains condition data D_{ij} that is obtained by

25   averaging monitored condition data RL and DSD for the time period

of day. For example, the average monitored data RL and DSD is

D_{22} at the time period T_2 of Monday. Such a table format is the

same with the "cloudy" and "rainy" tables.

Accordingly, if a time period of day, a day of week, a

5   weather condition and, if necessary, months for a fixed station

FS_i are provided, then the RF propagation condition around an

arbitrary fixed station FS_i can be estimated by searching the

statistical condition memory 206.

Statistical processing

10   As described before, each fixed station FS_i transmits

its monitored condition data back to the radio network control

station 20. The radio network control station 20 statistically

analyzes the monitored condition data to produce the

statistical condition data as shown in Figs. 6A and 6B. More

15   detailed statistical processing will be described

hereinafter.

Referring to Fig. 7, when having received monitored

condition data from fixed stations (YES in step S301), the processor

204 stores the received monitored condition data into the monitored

20   data memory 205 (step S302). Thereafter, the statistical analyzer

on the processor 204 reads monitored condition data for each

fixed station FS_i from the monitored data memory 205 and

statistically arranges them according to time periods of day

T_1-T_M, days of week, months and weather condition around the

25   fixed station FS_i to produce a set of statistical condition

tables as shown in Fig .6B (step S303). The set of statistical
condition tables for the fixed station FS_i is stored as an updated
one into the statistical condition memory 206 (step S304). The
steps S302-S304 are repeatedly performed at regular intervals.

5   An example of the step S303 will be described below.

        It is assumed that the radio network control station 20
receives a sequence of condition data D1, D2, … Dk from the
fixed station FS_1 for the time period T_2 of day on Sunday (fine
weather), where each of the condition data D1, D2, … Dk includes

10   a received-signal strength (RL) and a degree of received-signal
deterioration (DSD) such as bit-error rate. The statistical
analyzer calculates the average of condition data D1, D2, …
Dk and stores the average as an entry D_{12} of Fig. 6B into the
statistical condition tables for the fixed station FS_1 of the

15   statistical condition memory 206.

        In this manner, average condition data around each fixed
station is stored for each time period of day, each day of week,
each weather condition, and each month or season. Accordingly,
the condition data stored in the statistical condition memory

20   206 can be retrieved by designating a location, a time period
of day, a day of week, a weather condition and a month/season.

Radio parameter control

        It is assumed that the statistical condition data are
stored in the statistical condition memory 206 as shown in Fig.

25   6A and 6B.

It is further assumed for the sake of simplicity that the mobile station 60 equipped with the GPS receiver is moving, as shown in Fig. 1, near the fixed station FS_2 in the radio zone 41 and then enters the adjacent radio zone 51 toward the

5   fixed station FS_3 therein. Taking such a case as an example, the radio parameter control operation will be described hereinafter.

As described before, the mobile station 60 receives GPS data from GPS satellites 70 to compute the location of its own

10   from the GPS data and transmits the detected location information to the radio network control station 20 through a corresponding base station 40 or 50 at regular intervals.

Referring to Fig. 8, the radio network control station 20 receives the location data from the mobile station 60 through

15   the base station 40 at regular intervals (step S401).

If necessary, the radio network control station 20 transmits a monitor request to the mobile station 60 and the base station 40 communicating with each other to instruct them to measure a signal level (Ec) and an interference level (Io) (step S402).

20   In the case of W-CDMA (Wideband-CDMA), a monitor request is transmitted to a mobile station and a corresponding base station and thereafter they automatically transmit monitor reports to the radio network control station 20 at regular intervals.

When necessary data including monitor reports and weather

25   information have been received (YES in step S403), the mobile-station movement estimator on the radio network control

station 20 computes the moving direction and velocity of the mobile

station 60 from the received location information and then

estimates a location area to which the mobile station 60 will move

from the current location, based on the received location

5   information and the moving direction and velocity of the mobile

station 60 and the predetermined locations of the fixed stations

FS_1-FS_N (step S404).

In this example as shown in Fig. 1, the mobile station

60 passes by the fixed station FS_2 in the radio zone 41 and

10   then moves toward the fixed station FS_3 in the radio zone 51.

In this case, the mobile-station movement estimator first

estimates that the mobile station 60 moves closer to the location

area 41.2 of the fixed station FS_2. Therefore, the parameter

controller on the radio network control station 20 uses the

15   current time period, the calendar information and the received

weather information of today to search the statistical

condition memory 206 for statistical condition data at the fixed

station FS_2.

Based on the found statistical condition data at the fixed

20   station FS_2, the parameter controller predicts radio parameters

for the mobile station 60 and the base station 40 (step S405).

If it is predicted that a received signal strength at the fixed

station FS_2 becomes lower than a normal level, then the parameter

controller controls the radio parameters so as to increase a

25   transmission power level of the mobile station 60 and the base

station 40 by an amount compensating for such an estimated level

reduction (step S406). Contrarily, if it is predicted that a

received signal strength at the fixed station FS_2 becomes higher

than a normal level, then the parameter controller controls

the radio parameters so as to decrease a transmission power

5   level of the mobile station 60 and the base station 40 by an

amount compensating for such an estimated level increase (step

S406). In this example, a handover from the base station 40

to the base station 50 may be performed in the location area

41.2 of the fixed station FS_2.

10   Since the radio network control station 20 can know

how many mobile stations are now located in the location area

41.2 of the fixed station FS_2 based on the received location

information, if interference due to a large number of mobile

stations is estimated to occur, then the parameter controller

15   also controls the radio parameters for the relevant mobile stations

so as to adjust (decrease or increase) their transmission power

levels.

When the mobile station 60 enters the radio zone 51 and moves

toward the fixed station FS_3 in the radio zone 51,

20   the mobile-station movement estimator estimates that

the mobile station 60 moves closer to the location area 51.1

of the fixed station FS_3. Therefore, the parameter controller

uses the current time period, the calendar information and the

received weather information of today to search the statistical

25   condition memory 206 for statistical condition data at the

fixed station FS_3.

        Based on the found statistical condition data at the fixed

station FS$_3$, the parameter controller predicts radio parameters

for the mobile station 60 and the base station 50 (step S405).

If it is predicted that a received signal strength at the fixed

5   station FS$_3$ is lower than normal, then the parameter controller

controls the radio parameters so as to increase a transmission

power level of the mobile station 60 and the base station 50

by an amount compensating for such an estimated level reduction

(step S406).

10   Since the radio network control station 20 can know

how many mobile stations are now located in the location area

51.1 of the fixed station FS$_3$ based on the received location

information, the parameter controller also controls the radio

parameters for the relevant mobile stations to reduce

15   interference.

        As shown in Fig. 9, the radio network control station

20 maybeimplementedbyhardwarecircuits, inwhichastatistical

analyzer 209.1, a mobile-station movement estimator 209.2 and

a parameter controller 209.3 are implemented with hardware.

20   Since operations of the statistical analyzer 209.1,

the mobile-station movement estimator 209.2 and the parameter

controller 209.2 are the same as the above-described operations

of the statistical analyzer, mobile-station movement estimator

and parameter controller programs, the detailed descriptions

25   are omitted.

        As descried above, RF condition at a future location which

amobilestationwillreachcan be predictedbasedonstatistical

condition data and therefore necessary radio parameters can

be controlled depending on the predicted condition, achieving

a further highly accurate radio parameter control. Since the

5   statistical condition memory is updated at regular intervals,

the latest statistical condition data can be used to predict

RF condition at a desired location where a mobile station will make

an approach.